THE action of very diluted nitromuriatic acid (aqua regia) on meat and other animal substances has been recently studied by Signor Pavesi (*Giorn. Farm. Chim.* xxxi. 529), and he finds the substance an excellent preserving agent; meat in pieces of about 1 kg. kept in the liquid in wooden vessels remains unaltered and savoury for years. The meat treated may also be dried at 15° to 20° without undergoing change, apart from a diminution of volume and the appearance of a brown colour. Put for a few hours in water, the meat recovers its original softness and natural colour. The proportions of the acids in the preserving liquid are not given. The method is also adapted to preservation of animal substances for scientific purposes.

TWO shocks of earthquake occurred at Agram, the first at 8.44 p.m. on the 4th and the other about 1 a.m. on the 5th. Both were of a violent character, accompanied, as the former disturbances were, by a rolling, thundering noise underground. The direction of the motion was from north-east and south-west, and each shock lasted about four seconds. No damage has been done hitherto. A telegram from New York, February 5, states that earthquakes have occurred at Bloomington, Illinois, and Wolfborough, New Hampshire, U.S., but no serious consequences are reported.

THE German Aëronautical Society held its general meeting at Berlin on January 13 last. During 1882 no less than 230 proposals, principally relating to the steerage of balloons, were submitted to the Society, none, however, furthering the question in any material way.

A MEMBER of the Paris "École pratique d'acclimatation" has discovered a species of spider on the African coast, the firm and long web of which resembles yellow silk very closely, and is said to be almost as good as the product of real silkworms. The syndicate of the Lyons silk-merchants has closely investigated the matter, and the result is reported as highly favourable. There seems to be no difficulty in the way of acclimatising the new silk-producer in France.

NEWS has been received in Bolivia regarding Dr. Crevaux's mission. It appears that several members of this expedition were not killed, as was formerly reported, but are kept prisoners by the Tabo Indians.

THE Museum of the Berlin Society for Commercial Geography will be opened on April 1 next. From time to time there will be in this museum special exhibitions arranged by foreign states. Several of these are already announced. The best part of the Brazilian exhibition will remain in the Museum.

LIEUT. WISSMANN, the intrepid and successful German traveller, arrived at Cairo on January 1. His route from Loanda, by way of Nyangwe, on the Lualaba River, to Zanzibar, which measures about 3600 kilometres, led him for at least one-third of the distance through unexplored country. He has thus solved some of the enigmas of equatorial Africa. It is the southern half of the Congo basin through which Wissmann passed, and he found this to be most densely populated. This fact is remarkable, as it was entirely unexpected. Wissmann also passed through the land of a tribe of dwarf negroes. On the long and dangerous route from Lake Tanganyika to Zanzibar the traveller met with a most hospitable reception at the hands of the renowned brigand chief Mirambo, who supported him in every respect.

IN our last number we stated that M. Tissandier's electromagnetic machine had given a power of 4 horses per hour; it should have been 4 horse-power.

THE additions to the Zoological Society's Gardens during the past week include a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mrs. Norman; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Mrs. Sims; a Peregrine Falcon (*Falco peregrinus*) from North America, presented by Mr. C. H. Webster; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Mr. G. S. Northcote; four Ceylonese Terrapins (*Clemmys trijuga*) from Ceylon, four —— River Turtles (*Emyda* ——) from India, a Globose Curassow (*Crax globicera* ♀) from South America, deposited; a Blue-cheeked Amazon (*Chrysotis cœligena*) from Guiana, two Maximilian's Parrots (*Pionus maximiliani*) from Brazil, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), two Four-horned Antelopes *Tetraceros quadricornis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

DENNING'S COMET.—Mr. W. E. Plummer, of the University Observatory, Oxford, has made an interesting contribution to a branch of astronomical investigation, in which we have not shone greatly in this country, in the shape of a definitive determination of the elements of the orbit of the comet discovered by Mr. W. F. Denning, of Bristol, on the morning of October 4, 1881, which proved to be one of short period, though not previously observed. Accurate positions were obtained between October 5 and November 19 at Athens, Dun Echt, Harvard College, U.S., Marseilles, Odessa, Oxford, Palermo, Paris, Rome, and Strasburg. Starting with the second ellipse calculated by Dr. Hartwig, which assigned a revolution of 8·884 years, Mr. Plummer compares all the observations with an ephemeris computed therefrom. He then determines, by the method of variation of constants, for four-day intervals, the effect of perturbations by each of the planets from Mercury to Saturn inclusive, during the period of visibility; the influence of the perturbations upon the observed right ascensions and declinations being inferred by calculating the differential coefficients for variation of elements for the particular epochs, and these coefficients were used in the formation of equations of condition. The tabular longitudes of the sun were corrected by the results of observations at the Royal Observatory, Greenwich, supplied by the Astronomer-Royal. Normal equations were then formed and solved in the usual manner by least squares, and a corrected set of elements was thus found. The positions of the comet computed from them, and the positions inferred from the substitution of the corrections to the elements in the original equations of condition, agreed generally, but owing to their considerable amount, and the neglect of terms of the second order in calculating the differential coefficients, the agreement was not exact. Since Mr. Plummer's principal object was the determination of the comet's mean motion, he preferred to obtain the values of the several unknown quantities in terms of the mean motion, so that by successive small variations of this element, accompanied by the corresponding alterations in the others, several sets of elements could be formed, and the preferable orbit selected by direct comparison with the observations. This additional labour adds much to the value of Mr. Plummer's work. He accepts as the most trustworthy guide the sums of the squares of the errors in right ascension and declination, though the two do not correspond to precisely the same value of the mean motion, and so obtains the following definitive orbit:—

Epoch 1881, September 28·5 Greenwich M.T.

	°	′	″	
Mean anomaly	1	40	35·39	
Longitude of perihelion ...	18	36	12·8	Mean Eq. 1881·0
,, ,, ascending node	65	52	2·0	
Inclination	6	50	22·6	
Angle of eccentricity	56	8	28·4	
Log. semi-axis major	0·6315148			
Period of revolution	3235 days.			

Hence we find (the unit of distance being the earth's mean distance from the sun)—

Semi-axis major ...	4·28070	Eccentricity	0·8304135
,, minor ...	2·38498	Period in years ...	8 8567
Aphelion distance..	7·83545	The perihelion passage Sept. 13·43493 M.T. at Greenwich.	
Perihelion distance	0·72595		

The orbit of this comet is remarkable for the near approach it makes to the orbits of Venus, the Earth, and Jupiter. By Mr.

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Plummer's figures it appears that in longitude 223°·4 the comet is distant from the orbit of Jupiter only 0·145, a sufficient explanation of a probable cause of the short period of revolution.

THE GREAT COMET OF 1882.—The positions subjoined are extracted from an ephemeris published by Herr Stechert, of Berlin (*Astron. Nach.* No. 2486), and founded upon the elliptical elements of Dr. Kreutz:—

At Berlin Midnight

	Right Ascension.			Declination.		Distance from	
	h.	m.	s.	°	′	Earth.	Sun.
February 8	6	1	57	−20	5·8	2·412	3·008
10	6	0	17	19	34·5		
12	5	58	46	19	3·7	2·506	3·063
14	5	57	25	18	33·4		
16	5	56	12	18	3·6	2·602	3·118
18	5	55	8	17	34·4		
20	5	54	13	−17	5·7	2·700	3·172

ASTRONOMICAL TELEGRAMS.—Mr. Spencer F. Baird, Secretary of the Smithsonian Institution, notifies that arrangements have been completed with the Director of the Harvard College Observatory for conducting the system of telegraphic announcements of astronomical discoveries, which was established by the Institution in 1873, and that henceforward the American centre of reception and distribution of telegrams will be "The Harvard College Observatory, Cambridge, Massachusetts," to which all astronomical telegrams should in future be sent.

THE MATTER OF SPACE

OF late years there has been a growing tendency towards the belief that matter is present everywhere throughout the universe, as well in interstitial space as in the bodies of the spheres. Yet an older hypothesis is still widely held. The phenomena of light seem to require some substantial medium in space, but this substance has been viewed as specifically distinct from matter, and named ether. Another class of thinkers has devised still another species of substance. This is required to meet the demands of the new gravitation hypothesis; and consists of excessively minute particles, moving with intense speed, and pressing vigorously on the larger and slower particles of matter. In the past still other species of substance were imagined; heat, electricity, etc., were each ascribed to a specifically distinct substance.

Now, however, the tide has turned, and the inclination is to believe in only a single form of substance. There are, of course, countless distinct conditions produced by the aggregations of substance, and variations from simplicity to complexity, but this may not necessarily require more than a single kind of basic particle, or whatever we may call it. If the substantial contents of space are similar in constitution to the matter of the spheres, their state of existence must be much more simplified. In the spheres we have matter ranging from the simple elementary gases of the atmosphere, through the complex mineral compounds of the solid surface, to the highly compounded organic molecules. In outer space the variation is probably in the opposite direction, and substance may exist there in a condition much more highly disintegrated than the atmospheric gases. This view is not held by all theorists. Dr. Siemens argues that space holds molecules of considerable intricacy, comprising certain terrestrial elements, and their simpler compounds; as to the contents of space we know that there are very numerous solid masses, some of considerable size, others minute, and possibly ranging through many degrees from the largest to the minutest. Yet these really occupy but an inconsiderable portion of space, and apparently originated in solar or planetary orbs.

Such is, briefly stated, the state of knowledge and of hypothesis concerning the substantial contents of space. We need but add the uncertain reasons for arguing the presence of a resisting medium in space, and the necessity of a highly elastic condition of the light-conducting substance, to exhaust the subject so far as yet pursued.

It is held by some that the gravitation energy of the suns and planets is sufficiently great to sweep space of all contiguous material particles, except those solid masses which are saved from this fate by the vigour of their orbital motions. The atmospheres of suns and planets are retained with an energy very greatly in excess of their reverse energy of molecular motion, and therefore it is quite impossible that any of this material should escape into space, or that any similarly-conditioned material should exist contiguous to the spheres without being forced to become atmospheric matter. The centrifugal energy of the earth's atmosphere at the equator is only $\frac{1}{17}$ of that necessary to overcome gravity. The molecules of the atmosphere have also a vigour of heat vibration about equal to their centrifugal energy. Hence the resisting energy of these molecules is far below the gravitative energy, and they are vigorously held.

The question of the possible existence of gravitating matter in interspheral space depends strictly upon that of its motor energy. If the momentum of any particle, or of the whole sum of particles, be insufficient to constitute a centrifugal energy equal or superior to the centripetal energy of gravitation, then the material contents of space must inevitably be drawn into the attracting spheres, as atmospheric substance, and space be denuded of matter. If, on the contrary, the centrifugal energy of these particles be sufficient to resist gravitation, they will remain free, and space continue peopled by matter.

Such gravitative particles, wherever existing in space, could not be for an instant free from the influence of spheral attraction whatever their energy of motion. If this energy be too small, they must be related to the spheres as falling bodies, and must become atmospheric matter. If the two opposite energies be equal, they must be related to the spheres as planetary bodies, and circle in fixed orbits around the centre of attraction. If the centrifugal energy be in excess they must assume the condition of independent cometary bodies, temporarily influenced but not permanently controlled by any sun, and wandering eternally through space.

Such are the three possible conditions of the material contents of space. If the first obtain, space must be denuded of matter; if the second obtain, it will permanently contain matter in a partially elastic state; if the third obtain, it will permanently contain matter in a highly elastic state, since the pressure upon each other of the vigorously centrifugal particles must be great, and may be extreme. Of course no single particle could long retain its direction of motion, as related to any sphere. Constant impacts must constantly vary the directions of molecular motion. But the motion of each particle is successively transferred to a long series of particles, and thus is virtually continued in force and direction. Each motion pursues its course independently, though not as affecting any fixed particle of matter, and each particle aids in the progression of a vast network of motions, proceeding in every direction throughout the universe. Thus each particle, though not actually changing its place, may have motor relations which extend in every direction to the utmost extremes of space. It is a node in an interminable network of motions, and its incessant leaps throughout the limits of its narrow space are each part of a long motor line, which affects successively myriads of particles. So far as the energy of gravitation is concerned the effect upon this incessantly transferred motion is precisely the same as if the motion was confined to a single particle. If it lack energy the motion will be a falling one; if it equal the gravitative energy it will form a closed orbit. If it exceed the gravitative energy it will form an open curve, and be only temporarily controlled by any sphere.

In this interchange of motor energy certain particles may continually decrease in vigour of motion, and if near solar orbs may be drawn in as atmospheric matter. But they can only lose motion by transferring it to others, which would in consequence become more independent of gravity. The sum of motor energies in the universe must persist unchanged, and the aggregation of atmospheric substance around any planet must cause an outflow of motor energy which will increase the motor vigour of exterior particles. In such a case the height of atmosphere in any sphere will depend, partly on the attractive vigour of the sphere, and partly on the average motor vigour of the whole sum of matter. Every contraction and loss of motor energy by any portion of matter will increase the motor energy of remaining matter, and a fixed limit to the atmospheric control of every sphere must result, since in the outer layers of its atmosphere the centrifugal energy of molecular motion must increase until it equals the energy of gravitation.

Can we arrive at any conclusion as to which of the three possible conditions above considered really exists? If so we can answer the question as to the existence of matter as a constant tenant of space, and also reach some conclusions as to the character of its motor conditions.

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